Encyclopedia of Information Science and Technology

Second Edition

Mehdi Khosrow-Pour
Information Resources Management Association, USA

Volume V
Intero-Mo

Information Science REFERENCE

INFORMATION SCIENCE REFERENCE
Hershey · New York

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Cover Design: Lisa Tosheff
Printed at: Yurchak Printing Inc.

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue, Suite 200
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com/reference

and in the United Kingdom by
Information Science Reference (an imprint of IGI Global)
3 Henrietta Street
Covent Garden
London WC2E 8LU
Tel: 44 20 7240 0856
Fax: 44 20 7379 0609
Web site: http://www.eurospanbookstore.com

Library of Congress Cataloging-in-Publication Data

Encyclopedia of information science and technology / Mehdi Khosrow-Pour, editor. -- 2nd ed.
p. cm.
Includes bibliographical references and index.
Summary: "This set of books represents a detailed compendium of authoritative, research-based entries that define the contemporary state of knowledge on technology"--Provided by publisher.
ISBN 978-1-60566-026-4 (hardcover) -- ISBN 978-1-60566-027-1 (ebook)
1. Information science--Encyclopedias. 2. Information technology--Encyclopedias. I. Khosrowpour, Mehdi, 1951-
Z1006.E566 2008
004'.03--dc22
2008029068

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Mobile Spatial Interaction and Mediated Social Navigation

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INTRODUCTION

The increasing ubiquity of location and context-aware mobile devices and applications, geographic information systems (GIS) and sophisticated 3D representations of the physical world accessible by lay users is enabling more people to use and manipulate information relevant to their current surroundings (Scharl & Tochtermann, 2007). The relationship between users, their current geographic location and their devices are summarised by the term "mobile spatial interaction" (MSI), and stands for the emerging opportunities and affordances that location sensitive and Internet capable devices provide to its users. The first major academic event which coined the term in its current usage was a workshop on MSI (see http://msi.ftw.at/) at the CHI 2007 (Fröhlich et al., 2007).

Mobile spatial interaction is grounded in a number of technologies that recently started to converge. First, the development of mobile networks and mobile Internet technologies enables people to request and exchange specific information from anywhere at anytime. Using their handheld devices people can, for example, check the latest news, request recent stock exchange values or communicate via mobile instant messaging. The second enabler is global positioning technology. Mobile devices with integrated Global Positioning System (GPS) receivers—soon to be joined by the Russian Global Navigation Satellite System (GLONASS) and the European Galileo system—are aware of their current latitude and longitude coordinates and can use this data as value added information for context-aware services, that is, mobile applications that refer to information relevant to the current location of the user. A possible use scenario for such an information request would be, for example, "find all clubs and pubs in a radius of 500 meters from my current position." The focus of this work is to enrich the opportunities given by such location aware services with selected Web 2.0 design paradigms (Beer & Burrows, 2007; Kolbitsch & Maurer, 2006) toward mobile social networking services that are bound to specific physical places. User participation, folksonomy and geotagging are three design methods that have become popular in Web 2.0 community-platforms and proven to be effective information management tools for various domains (Casey & Savastinuk, 2007; Courtney, 2007; Macgregor & McCulloch, 2006). Applying such a design approach for a mobile information system creates a new experience of collaboration between mobile users, a step toward what Jaokar refers to as the Mobile Web 2.0 (Jaokar & Fish, 2006), that is, a chance for mediated social navigation in physical spaces.

BACKGROUND

Applications based on mobile spatial interaction can be classified into four different categories (Fröhlich et al., 2007): 1) Systems that facilitate navigation and wayfinding in geographic places: This category is, for example, represented by car navigation systems that assist the driver, for example, with interactive maps, arrows or spoken instructions providing directions to the address of destination (Baus, Krüger, & Wahlster, 2002; Kray, Elting, Laakso, & Coors, 2003); 2) Mobile augmented reality applications such as the head-mounted display (HMD) of virtual information added to objects in the physical world, (Bruce, Piekarski, Hepworth, Gunther, & Demczuk, 1998; Piekarski & Bruce, 2002); 3) Applications creating; or 4) providing access to information that is attached to physical places or objects: For such applications, geotagging, a method to attach latitude and longitude identifiers, enables information resources such as text, pictures or videos to be put into a specific geographic context (Torniai, Battle, & Cayzer, 2005).

In categories 3 and 4, which represent the fields relevant to our work, most of the previous studies focus on techniques that allow people to create or access locative information and share their personal stories, thoughts, experiences and knowledge about specific places. Lancaster University's GUIDE project, for example, is an electronic tourist guide that provides users with context-aware information, depending on their profile, interests and location (Cheverst, Davies, Mitchell, Friday, & Efstratiou, 2000). On the other hand, GeoNotes (Espinoza et al., 2001) and Urban Tapestries (West, 2005) allow mobile users to not only read but

also create spatially contextualised content. They can attach virtual sticky notes to particular latitude and longitude coordinates. Equipped with Wi-Fi-enabled personal digital assistants (PDA), users can then see other users' notes that were left behind in their current immediate surroundings. E-graffiti, a context-aware application evaluated on a college campus, detects each participating student's location on the campus and displays notes that were left behind by other students (Burrell & Gay, 2002). Just-for-Us (Kjeldskov & Paay, 2005) helps a group of friends in a city to identify an appropriate place to meet depending on their individual current locations, and the George Square project (Brown et al., 2005) focuses on location, photography and voice sharing functions to let on-site and off-site users collaboratively explore a city sight.

Besides the various use scenarios, the applications primarily differ in the interaction design of specific features (Tungare, Burbey, & Perez-Quinones, 2006), for example, access virtual post-its from remote places (Espinoza et al., 2001; West, 2005) vs. in-situ access (Burrell & Gay, 2002; Rohs, 2005), push (Espinoza et al., 2001; Kjeldskov & Paay, 2005) vs. pull services, expiration dates of the messages or private vs. public messaging (Burrell & Gay, 2002; Espinoza et al., 2001). However, not much work has yet been carried out on studying different interaction techniques between the information provider and information consumer of geographically contextualised content. The focus of our work is on evaluating direct and indirect interaction methods, such as phone calls, text messages and whiteboard messages that can be described and retrieved via folksonomy tags.

MOBILE SPATIAL INTERACTION AS AN ENABLER FOR MEDIATED SOCIAL NAVIGATION IN PHYSICAL SPACES

Our physical world holds certain characteristics that enable us to interpret what other people have done, how they behaved and where they have travelled. Sometimes, we can see traces on physical objects that provide hints about people's actions in the past. Footprints on the ground left by previous walkers can show us the right way through a forest, or in a library, for example, dog-eared books with well-thumbed pages might be worthwhile reading, as they indicate the popularity of the text. The phenomenon of people making decisions about their actions based on what other people have done in the past or what other people have recommended doing, forms part of our everyday social navigation. The concept of social navigation describes the "moving towards a cluster of other people, or selecting objects because others have been examining them" (Dourish & Chalmers, 1994).

Social navigation in its classic sense is often restricted to visible traces that were intentionally or unintentionally left behind by earlier navigators, and indicate a former interaction between them and an object in the physical world. While some previous work use social navigation as a design concept to enhance navigation and wayfinding in virtual spaces such as Web browsing or online shopping (Dieberger, 1995, 1997; Dieberger, Dourish, Höök, Resnick, & Wexelblat, 2000; Dourish & Chalmers, 1994; Erickson & Kellogg, 2000; Forsberg, Höök, & Svensson, 1998; Höök, Benyon, & Munro, 2003; Svensson, 2002; Svensson, Höök, & Cöster, 2005), a different approach is to leverage multimedia and virtual information spaces to enhance social navigation in the physical world, which we refer to as "mediated social navigation." The technical infrastructure comprising mobile Internet and global positioning systems paves the way for mediated social navigation using mobile phones. They enable users to add multimedia content to physical places or objects and overlay the real world with a virtual information space that can then be requested by mobile users (Burrell & Gay, 2002; Jaokar & Fish, 2006), and more specifically, create a mediated social environment. Such applications not only provide hints about what somebody has done at a specific place, but he or she can document this with text, photos, audio and video recordings. Such an infrastructure based on user generated content makes use of mediated social navigation to enable mobile users to effectively exchange local knowledge (Foth, Odendaal, & Hearn, 2007).

In our study, we explored the appropriateness of principles that guide the design of a mobile phone application to support social navigation in physical environments (Bilandzic & Foth, 2007a). Targeting the specific domain of public inner-city places, we have designed "CityFlocks," a mobile system enabling urban residents to leave digital annotations with ratings, recommendations or comments on any place or physical object in the city. Thus, CityFlocks turns residents into in-situ amateur journalists for the benefit of visitors or other residents who have questions or need navigational aid related to any place in the city. Furthermore, it provides two interaction alternatives to let people collectively share information about places in their city or neighbourhoods, one following a direct and the other an indirect social navigation approach (Dieberger, 2003; Svensson, 2002). The direct social navigation feature enables information seekers to set up a direct voice link with a local resident who has agreed to voluntarily provide local information to visitors and other residents. The indirect approach produces a dynamic list of virtual, location-based messages, authored and rated by local residents that provide information about the respective place. In order to retrieve a virtual message or an appropriate voice-link partner, CityFlocks provides a built-in search function based on the folksonomy concept. Folksonomy is a user-generated taxonomy, initially applied to categorise and retrieve Web content such as Web pages or photographs, using open-ended labels called tags (Vander Wal, 2007). For every entry users submit, they can attach a number of

tags to describe the comment and place they are submitting. Other CityFlocks users can then search for such tags to find the recommendations and places they are looking for. The underlying database is designed to allow users to request tags that other people have used to describe similar places. In doing so, one can use the community's collective intelligence to find related places. Similar to Amazon's (http://amazon.com) recommendation feature ("customers who bought this item also bought this item"), CityFlocks identifies correlations between the user generated tags to propose places that are related to one's initial search request.

FUTURE TRENDS

There are two major research fields regarding future MSI-applications: On the one hand enhanced positioning methods and technologies need to be further developed. New approaches embrace a seamless mix of various positioning technologies, such as GPS, Wifi-Fingerprinting (Taheri, Singh, & Agu, 2004) and Radio Frequency Identification (RFID) to ensure precise location awareness where a single technology on its own would fail, for example, GPS in indoor locations or Wi-Fi fingerprinting in rural areas.

The second research field deals with usability issues and the creation of appropriate interaction techniques for the various types and use scenarios of MSI applications. In our CityFlocks project, for example, we propose an innovative interaction type for end-user information systems (Bilandzic & Foth, 2007b) by combining Web 2.0 techniques such as geotagging, folksonomy or user-generated content with context-aware features and direct voice link capabilities on mobile phones. The outcomes provide valuable input into the process of designing future community-driven, mobile information systems. This study continues and expands our work in the area of urban informatics (Foth, 2006, 2008, in press; Foth & Hearn, 2007; Klaebe, Foth, Burgess, & Bilandzic, 2007). Only if designers manage to create intuitive and easy-to-learn interfaces, MSI applications might be adopted and used by the broad mass of users. However, there are some other critical factors such as privacy and social acceptance issues where further studies need to be carried out.

CONCLUSION

Originally, social navigation was restricted to visible interaction histories that were naturally left behind and thus relied on earlier physical interaction between people and the respective object. People interpret these hints as a message, recommendation, warning or just a note telling them something about the type of interaction the previous navigator had with the object. With a clever mix of modern mobile information and communication technology and a set of Web 2.0 technologies, social navigation methods can be enhanced in physical spaces (Höök, 2003). There is an emerging trend that takes advantage of the network connectivity of mobile phone users to create a mediated social environment where people who are interested in particular geographic locations can exchange information, personal opinions and experiences with the respective place. This would, for example, enable visitors of a new city to access the knowledge and experiences from local residents about inner-city facilities. This mind-shift in designing mobile services toward a high engagement of individuals has great potential to enhance peoples' experience when navigating physical spaces (Höök, 2003; Jaokar & Fish, 2006). Turning mobile phone users into in-situ journalist who can upload location-based ratings, comments and recommendations to a shared community platform will eventually form a huge social knowledge repository decentralising control over information about local services.

The idea of the proposed service targets a community-driven urban information service and is meant to provide an infrastructure to let residents become authors of information regarding their own neighbourhoods and make them available for interested people in the city, for example, visitors and tourists. This design approach proposes a new type of mobile information systems, providing the benefits of mediated social navigation to MSI applications. It leverages Web 2.0 techniques toward an effective collaboration between mobile users in order to enhance social navigation in physical spaces.

REFERENCES

Baus, J., Krüger, A., & Wahlster, W. (2002). A resource-adaptive mobile navigation system. In *Paper presented at the International Conference on Intelligent User Interfaces*, San Francisco, CA, USA.

Beer, D., & Burrows, R. (2007). Sociology and, of and in Web 2.0: Some initial considerations. *Sociological Research Online, 12*(5).

Bilandzic, M., & Foth, M. (2007a). CityFlocks: Designing social navigation for urban mobile information systems. In *Paper presented at the ACM SIGCHI Designing Interactive Systems (DIS) Conference*.

Bilandzic, M., & Foth, M. (2007b). Transferring Web 2.0 paradigms to a mobile system for social navigation in public inner-city places. In *Paper presented at the Towards a Social Science of Web 2.0 Conference*.

Brown, B., Chalmers, M., Bell, M., Hall, M., MacColl, I., & Rudman, P. (2005, September 18-22). Sharing the square:

Collaborative leisure in the city streets. In *Paper presented at the Proceedings of the Ninth European Conference on Computer-Supported Cooperative Work*, Paris, France.

Bruce, T., Piekarski, W., Hepworth, D., Gunther, B., & Demczuk, V. (1998). A wearable computer system with augmented reality to support terrestrial navigation. In *Paper presented at the 2nd IEEE International Symposium on Wearable Computers*.

Burrell, J., & Gay, G. K. (2002). E-graffiti: Evaluating real-world use of a context-aware system. *Interacting with Computers, 14*(4), 301-312.

Casey, M. E., & Savastinuk, L. C. (2007). *Library 2.0: The librarian's guide to participatory library service*. Medford, NJ: Information Today.

Cheverst, K., Davies, N., Mitchell, K., Friday, A., & Efstratiou, C. (2000, April). *Developing a context-aware electronic tourist guide: Some issues and experiences.* In Paper presented at CHI 2000, The Netherlands.

Courtney, N. (2007). *Library 2.0 and beyond: Innovative technologies and tomorrow's user*. Westport, CT: Libraries Unlimited.

Dieberger, A. (1995). Providing spatial navigation for the World Wide Web. In A. U. Frank & W. Kuhn (Eds.), *Spatial Information Theory: Proceedings of Cosit '95* (pp. 93-106). Semmering, Austria: Springer-Verlag.

Dieberger, A. (1997). Supporting social navigation on the World Wide Web. *International Journal of Human-Computer Studies, special issue on innovative applications of the Web, 46*, 805-825.

Dieberger, A. (2003). Social connotations of space in the design for virtual communities and social navigation. In K. Höök, D. Benyon, & A. J. Munro (Eds.), *Designing information spaces: The social navigation approach* (pp. 293-313). London: Springer-Verlag.

Dieberger, A., Dourish, P., Höök, K., Resnick, P., & Wexelblat, A. (2000). Social navigation: Techniques for building more usable systems. *Interactions, 7*(6), n/a.

Dourish, P., & Chalmers, M. (1994). Running out of space: Models of information navigation. In *Paper presented at the HCI'94*.

Erickson, T., & Kellogg, W. A. (2000). Social translucence: An approach to designing systems that support social processes. *ACM Transactions on Computer-Human Interaction, 7*(1), 59-83.

Espinoza, F., Persson, P., Sandin, A., Nyström, H., Cacciatore, E., & Bylund, M. (2001). GeoNotes: Social and navigational aspects of location-based information systems. In *Paper presented at the Ubicomp 2001: Ubiquitous Computing, International Conference*.

Forsberg, M., Höök, K., & Svensson, M. (1998). Design principles for social navigation tools. In *Paper presented at the UI4All*, Stockholm, Sweden.

Foth, M. (2006). Facilitating social networking in inner-city neighborhoods. *IEEE Computer, 39*(9), 44-50.

Foth, M. (2008, in press). *Urban informatics: Community integration and implementation.* Hershey, PA: Information Science Reference, IGI Global.

Foth, M., & Hearn, G. (2007). Networked individualism of urban residents: Discovering the communicative ecology in inner-city apartment complexes. *Information, Communication & Society, 10*(5), 749-772.

Foth, M., Odendaal, N., & Hearn, G. (2007). *The view from everywhere: Towards an epistemology for urbanites.* In Paper presented at the 4th International Conference on Intellectual Capital, Knowledge Management and Organisational Learning (ICICKM), Cape Town, South Africa.

Fröhlich, P., Simon, R., Baillie, L., Roberts, J. L., Murry-Smith, R., Jones, M., et al. (2007). In *Proceedings of the Workshop on Mobile Spatial Interaction*, San Jose, CA, USA.

Höök, K. (2003). Social navigation: From the Web to the mobile. In G. Szwillus & J. Ziegler (Eds.), *Mensch & Computer 2003: Interaktion und Bewegung* (pp. 17-20). Stuttgart, Germany.

Höök, K., Benyon, D., & Munro, A. J. (2003). *Designing information Spaces: The social navigation approach*. London, New York: Springer-Verlag.

Jaokar, A., & Fish, T. (2006). *Mobile Web 2.0: The innovator's guide to developing and marketing next generation wireless mobile applications*. London: Futuretext.

Kjeldskov, J., & Paay, J. (2005). Just-for-us: A context-aware mobile information system facilitating sociality. In Proceedings of the *ACM International 7th International Conference on Human Computer Interaction with Mobile Devices & Services,* table of contents, (Vol. 111, pp. 23-30).

Klaebe, H., Foth, M., Burgess, J., & Bilandzic, M. (2007). Digital storytelling and history lines: Community engagement in a master-planned development. In *Paper presented at the 13th International Conference on Virtual Systems and Multimedia (VSMM'07),* Brisbane, Australia.

Kolbitsch, J., & Maurer, H. (2006). The transformation of the Web: How emerging communities shape the information we consume. *Journal of Universal Computer Science, 12*(2), 187-213.

Kray, C., Elting, C., Laakso, K., & Coors, V. (2003). Presenting route instructions on mobile devices. In *Paper presented at the International Conference on Intelligent User Interfaces*.

Macgregor, G., & McCulloch, E. (2006). Collaborative tagging as a knowledge organisation and resource discovery tool. *Library Review, 55*(5).

Piekarski, W., & Bruce, T. (2002). ARQuake: The outdoor augmented reality gaming system. *Communications of the ACM, 45*(1), 36-38.

Polanyi, M. (1966). *The tacit dimension*.

Rohs, M. (2005). Real-world interaction with camera phones. *Ubiquitous computing systems* (pp. 74-89). Berlin/Heidelberg: Springer-Verlag.

Scharl, A., & Tochtermann, K. (Eds.). (2007). *The geospatial Web: How geo-browsers, social software and the Web 2.0 are shaping the network society.* Heidelberg, Germany: Springer-Verlag.

Svensson, M. (2002). *Defining, designing and evaluating social navigation.* Stockholm University.

Svensson, M., Höök, K., & Cöster, R. (2005). Designing and evaluating Kalas: A social navigation system for food recipes. *Computer-Human Interaction, 12*(3), 374-400.

Taheri, A., Singh, A., & Agu, E. (2004). Location fingerprinting on infrastructure 802.11 wireless local area networks. In *Proceedings of the 29th Annual IEEE International Conference on Local Computer Networks*, (pp. 676–683).

Torniai, C., Battle, S., & Cayzer, S. (2005). *Sharing, discovering and browsing geotagged pictures on the Web*.

Tungare, M., Burbey, I., & Perez-Quinones. (2006). Evaluation of a location-linked notes system. In *Paper presented at the 44th ACM Southeast Regional Conference,* Melbourne, FL.

Vander Wal, T. (2007). *Folksonomy coinage and definition*. Retrieved May 31, 2008, from http://vanderwal.net/folksonomy.html

West, N. (2005). Urban tapestries: Experimental ethnography, technological identities and place. *Cultural Snapshot, 10*.

KEY TERMS

Mobile Social Navigation: The process of guiding activities aimed at determining our position and planning and following a specific route based on what other people have done or what other people have recommended doing, using mobile devices. First introduced by Dourish and Chalmers (1994), they describe social navigation as "moving toward a cluster of other people, or selecting objects because others have been examining them."

Local Folksonomies: In the context of the Web 2.0 discussion, a folksonomy (sometimes also known as a "tag cloud") is a user-generated taxonomy made up of key terms that describe online content. By assigning these freestyle keywords or so-called "tags," the semantics of various information resources can be described in a more flexible, decentralised, collaborative and participatory way than fixed categories allow for. The term has been coined by Thomas Vander Wal.

Geotagging: An approach which adds latitude and longitude identifiers as metadata to online content. It enables people to embed their information resources such as text, pictures or videos in a specific spatial and semantic context to augment the physical world with virtual information. Such a mediated social environment can help people navigate physical spaces by using location aware mobile devices.

Mobile Web 2.0: The suite of systems and mobile devices which either run existing Web 2.0 applications or re-appropriate according characteristics (tagging, user participation, mash-ups, personalisation, recommendations, social networking, collective intelligence, etc.) for the specific context of mobile use and mobile devices.

Context-aware Mobile Devices and Applications: Applications that react or provide information based on the user's context. The context is defined by a vector of selected data, for example, representing his/her current geographic location, emotional state, physical conditions (e.g. light, noise) or other variables that describe the user's current situation. Devices that run context-aware applications are usually equipped with sensors to perceive the environment or make assumptions via intelligent algorithms.

Local Knowledge: Knowledge, or even knowing, is the justified belief that something is true. Knowledge is thus different from opinion. Local knowledge refers to facts and information acquired by a person which are relevant to a specific locale or have been elicited from a place-based context. It can also include specific skills or experiences made in a particular location. In this regard, local knowledge can be tacitly held, that is, knowledge we draw upon to perform and act but we may not be able to easily and explicitly articulate it: "We can know things, and important things, that we cannot tell" (Polanyi, 1966).

Global Positioning System (GPS): A set of earth orbit satellites transmit microwave signals which can be received with so-called GPS-receivers. By comparing the timestamps of signals from different satellites, GPS-receivers can determine their geographic location. Each position can be described by a set of latitude and longitude coordinates.